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Eustatic, tectonic, and climatic signatures in the Lower Cretaceous siliciclastic succession on the Eastern Russian Platform

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ABSTRACT

A methodical approach to identifying major abiotic events in the siliciclastic succession accumulated in the shallow epicontinental basin on the Eastern Russian Platform during the Early Cretaceous is presented. On the basis of a reliable chronostratigraphic framework a comparison between global and regional sea level curves was undertaken. The intervals during which the global and regional sea level curve trends are similar correspond to a predominance of eustasy in the particular basin. Alternatively, tectonic activity dominates during intervals when there is no similarity between the trends of the global and regional sea level curves. Three intervals of non-coincidences of trends of these two curves matched with major tectonic events that took place within the Eastern Russian Platform in the Early Cretaceous: the Early Hauterivian tectonic uplift, subsequent Late Hauterivian subsidence and the Late Albian uplift. The main consequences of the tectonic activity were two large regional unconformities and hiati. The comparison of main global and regional sea level trends also reveals major climatic events. "The cold snaps" that occurred during the Early Cretaceous greenhouse world (Hu et al., 2012) coincided with simultaneous global and regional sea level lowstands, peak shallowing of the basin and the almost complete absence of sediments. "The cold snap" is identified in the Late Aptian sedimentary sequences on the Eastern Russian Platform.

1. Introduction

An extensive amount of published data on sequence stratigraphy shows that the subdivision of geological successions into sequences, together with the analysis of tectonic activity and eustatic changes, allows for a deeper understanding of basin evolution. Thus, genetic relationships between the Lower Cretaceous sediments of the Russian Platform and global sea level changes in conjunction with tectonic activity and sediment supply were defined by analyzing a voluminous amount of well data from the Central Russian Platform (Sahagian and Jones, 1993; Sahagian et al., 1996) and on the basis of reliable chronostratigraphic analyses of the particular sections and further regional-scale investigations on the Eastern Russian Platform (Zorina, 2009; Zorina et al., 2009; Zorina, 2012). The most important results of the latter were the regional sea level curve and the regional tectonic curve that have been produced for the Mid Jurassic–Lower Cretaceous of the Eastern Russian Platform (Zorina, 2012).

In this study a new methodical approach for identifying major abiotic events in the Early Cretaceous epicontinental Russian sea is presented. It is shown that tectonic subsidences–uplifts and the so-called climatic "cold snaps" can be detected by the comparison between global and regional sea level curves. Importantly, widely discussed Early Cretaceous cooling events can be identified in the geological sections without isotopic and other "high-tech" data. The causes and consequences of major Early Cretaceous abiotic events on the Eastern Russian Platform, including Oceanic Anoxic Event-1a (OAE-1a), are also discussed.

It should be noted that the results of present study, based on the basin depth estimations, strongly differ from the recent analysis attempted by Zorina and Ruban (2012) in which shoreline shifts (reflecting transgressions and regressions) were taken into account. An urgency of such a distinction was previously argued by Ruban (2007) and it was recently clarified by modeling different transgressive–regressive and shallowing–deepening situations in the sedimentary basin (Zorina, 2014).

2. Geologic setting and chronostratigraphic position of the Lower Cretaceous megasequences

Current understanding of the occurrence and distribution of the Lower Cretaceous deposits within the Eastern Russian Platform (Fig. 1) is mainly the result of voluminous stratigraphic data that have been compiled and published (e.g., Sasonova and Sasonov, 1967; Vereshchagin and Ronov, 1969; Chirva, 1993). However, this information is not used for the purposes of chronostratigraphy.

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